

We claim:

- 1 1. A carrier for planarizing a first surface of a work piece comprising:  
2 a carrier housing;  
3 a carrier insert coupled to the work piece carrier housing, the carrier insert comprising:  
4 a work piece bladder having a work piece diaphragm with a surface configured  
5 to press against a second surface of a work piece and having a plurality of ribs integrally formed  
6 with the work piece diaphragm;  
7 an optically transparent carrier backing plate adapted for coupling to the carrier  
8 housing; and  
9 a plurality of clamps for sealing the ribs to the carrier backing plate;  
10 a plurality of web plenums bounded by the work piece diaphragm, ribs, and  
11 carrier backing plate and in each of which the pressure can be controlled; and  
12 a plurality of carrier plenums bounded by the ribs and the carrier backing plate  
13 and in each of which the pressure can be controlled to control pressure exerted on a  
14 corresponding one of the plurality of ribs; and  
15 a floating wear ring coupled to the carrier housing and surrounding and closely spaced  
16 apart from the work piece bladder.
- 1 2. The carrier of claim 1 wherein the floating wear ring comprises a thick portion adjacent  
2 the outer periphery of the wear ring and a thin portion adjacent the inner periphery of  
3 the wear ring, the thin portion configured to accommodate one of the plurality of clamps  
4 sealing the outermost of the ribs to the carrier backing plate.
3. The carrier of claim 1 wherein each of the plurality of ribs comprises an expanded  
portion that facilitates sealing between the rib and the carrier backing plate.
4. The carrier of claim 3 wherein the expanded portion comprises a bulbous portion and an  
alignment portion.
5. The carrier of claim 1 wherein the carrier backing plate comprises a plurality of  
individual components coupled together by the plurality of clamps.

6. The carrier of claim 1 wherein the plurality of carrier plenums comprise circular channels formed in the carrier backing plate.
7. The carrier of claim 1 wherein the floating wear ring is coupled to the carrier housing by a wear ring diaphragm that bounds one portion of a wear ring plenum in which the pressure can be adjusted.
8. The carrier of claim 1 wherein a first clamp of the plurality of clamps is positioned to surround the periphery of the work piece bladder, and the remaining clamps of the plurality of clamps are positioned within the plurality of web plenums.
9. The carrier of claim 8 wherein the floating wear ring comprises toroidal ring having a thick outer portion and a thin inner portion, the thin inner portion configured to avoid contact between the first clamp and the floating wear ring.
10. A carrier for planarizing a first surface of a work piece comprising:
  - 1 a carrier housing;
  - 2 a circular work piece bladder having a surface configured to press against a second
  - 3 surface of a work piece;
  - 4 a circular clamp surrounding the work piece bladder and coupling the work piece
  - 5 bladder to the carrier housing;
  - 6 a wear ring coupled to the carrier housing and surrounding the work piece bladder, the
  - 7 wear ring having a cross sectional shape configured to allow an inner diameter of the wear ring
  - 8 to be spaced near an edge of the work piece bladder and to avoid contact between the wear ring
  - 9 and the circular clamp.
  - 10
11. The carrier of claim 10 wherein the wear ring comprises a toroidal structure having a thick portion at the outer periphery thereof and a thinner portion at the inner diameter thereof.
12. The carrier of claim 11 further comprising a wear ring diaphragm coupling the wear ring to the carrier housing and partially enclosing a wear ring plenum in which the pressure can be adjusted.

1 13. A carrier insert for a CMP apparatus comprising:  
2 a work piece bladder comprising a work piece diaphragm and a plurality of concentric  
3 ribs integrally formed with the work piece diaphragm;  
4 an optically transparent carrier backing plate adapted for coupling to the CMP  
5 apparatus; and  
6 a plurality of circular clamps coupled to the carrier backing plate and sealing the  
7 plurality of ribs to the carrier backing plate.

14. The carrier insert of claim 13 further comprising a plurality of web plenums bounded by the work piece diaphragm, the concentric rings and the carrier backing plate.

15. The carrier insert of claim 14 further comprising a plurality of carrier plenums formed in the carrier backing plate, each of the plurality of carrier plenums bounded by one of the plurality of concentric ribs.

16. The carrier insert of claim 15 further including a plurality of holes formed in the carrier backing plate for coupling the plurality of carrier plenums and plurality of web plenums to fluid carrier paths in the CMP apparatus.

17. The carrier insert of claim 13 wherein the carrier backing plate comprises a plurality of toroidal rings.

18. The carrier insert of claim 17 wherein the plurality of toroidal rings are coupled together in a unitary structure by the plurality of circular clamps.

1 19. The carrier insert of claim 13 wherein each of the plurality of concentric ribs comprises  
2 a first portion joined to the work piece diaphragm and extending orthogonally therefrom, and a  
3 second expanded portion at the extremity of the rib to facilitate sealing of the rib to the carrier  
4 backing plate by at least one of the plurality of circular clamps.

20. The carrier insert of claim 19 wherein the second expanded portion comprises a shaped portion including a first bulbous portion and a second alignment portion.

1 21. A work piece bladder for use with a CMP apparatus comprising a work piece diaphragm  
2 having a first surface adapted for pressing against a surface of a work piece and a plurality of  
3 concentric ribs extending substantially orthogonally from a second surface of the work piece  
4 diaphragm, each of the plurality of concentric ribs terminating in an expanded portion  
5 substantially parallel to the work piece diaphragm, the expanded portion adapted for clamping  
6 to a carrier backing plate of a CMP apparatus.

22. The work piece bladder of claim 21 wherein the expanded portion further comprises a  
shaped, upwardly extending portion having a first bulbous portion and a second alignment  
portion.

1 23. A method for planarizing a first surface of a work piece utilizing a CMP apparatus  
2 comprising: a polishing pad, a work piece diaphragm supported by a plurality of ribs including  
3 an outermost rib, each of the ribs having a pressure adjustable carrier plenum associated  
4 therewith, the work piece diaphragm having a first surface for pressing against a second surface  
5 of the work piece, a plurality of pressure adjustable web plenums positioned adjacent a second  
6 surface of the work piece diaphragm, and a wear ring surrounding the work piece diaphragm  
7 and configured to press against the polishing pad, the pressure with which the wear ring presses  
8 against the polishing pad being adjustable, the method comprising the steps of:  
9 positioning a second surface of a work piece adjacent the first surface of the work piece  
10 diaphragm;  
11 positioning the first surface of the work piece in contact with the polishing pad;  
12 establishing a predetermined pressure in each of the pressure adjustable web plenums;  
13 pressing the wear ring against the polishing pad with a predetermined force;  
14 adjusting, independent of the predetermined force, the pressure in the carrier plenum  
15 associated with the outermost rib; and  
16 initiating relative motion between the work piece diaphragm and the polishing pad.

24. The method of claim 23 wherein the step of adjusting comprises the step of adjusting  
the pressure in the carrier plenum associated with the outermost rib independent of the pressure  
established in each of the pressure adjustable web plenums.

25. The method of claim 23 further comprising the step of adjusting the pressure in each of the pressure adjustable carrier plenums, the pressure in the carrier plenum associated with the outermost rib being adjusted independently of the pressure in each of the other carrier plenums.

1 26. A method for planarizing a first surface of a work piece utilizing a CMP apparatus  
2 comprising: a polishing pad; a work piece diaphragm supported by at least an outermost  
3 pressure adjustable member aligned with an extreme outer perimeter of the work piece, and  
4 having a first surface for pressing against a second surface of the work piece; at least one  
5 pressure adjustable web plenum positioned adjacent a second surface of the work piece  
6 diaphragm; and a wear ring surrounding the work piece diaphragm and configured to press  
7 against the polishing pad, the pressure with which the wear ring presses against the polishing  
8 pad being adjustable, the method comprising the steps of:  
9 positioning a second surface of a work piece adjacent the first surface of the work piece  
10 diaphragm;  
11 establishing a predetermined pressure in the at least one web plenum;  
12 pressing the wear ring against the polishing pad with a predetermined force;  
13 adjusting, independent of the predetermined force, the pressure of the outermost  
14 pressure adjustable member; and  
15 initiating relative motion between the work piece diaphragm and the polishing pad.

1 27. The method for planarizing a first surface of a work piece of claim 26, further  
2 comprising the steps of:  
3 measuring the material removal profile across the first surface of the workpiece; and  
4 adjusting at least one of the wear ring pressing force, the pressure of the outermost  
5 pressure adjustable member, and the web plenum pressure based on the material removal  
6 profile measurement.

28. The method for planarizing a first surface of a work piece of claim 26, wherein the outermost pressure adjustable member comprises a rib and pressure adjustable carrier plenum associated therewith.

29. The method for planarizing a first surface of a work piece of claim 28, wherein the at least one pressure adjustable web plenum comprises a plurality of pressure adjustable web

plenums positioned against the second surface of the work piece diaphragm.